Blood Lead Concentration and Delayed Puberty in Girls

S.G. Selevan,[1] D.C. Rice,[1] K.A. Hogan,[2] S.Y. Euling,[1] A. Pfahles-Hutchens,[3] J. Bethel[4]

1. EICG/NCEA-Wash/ORD; 2. IRIS/NCEA/ORD; 3. OPPTS; 4. Westat, Inc.

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Healthy Communities and Ecosystems

Association between environmental factors and puberty timing?

Earlier onset or progression of puberty

- **PBBs (Blanck et al., 2000)**
- **Organochlorine pesticides (Krstevska-Konstantinova et al., 2001)**
- **Phthalates (girls – Colon et al., 2002)**

Later onset or progression of puberty

- **PAHs, Dioxins (Den Hond et al., 2002)**

Lead and timing of puberty?

Lead exposure could affect timing of puberty . . .

Indirectly through effects on growth

- **Early life exposure associated with growth restriction in animals and humans**
- **Onset of puberty can be affected by growth and maturation (BMI, weight, and height)**

Directly through effects on the endocrine system

- **Hypothalamic-pituitary-gonadal (HPG) axis**
- **Effects on calcium homeostasis and bone growth**

Measures of Puberty

Age at menarche

Tanner stage

- **Breast development**
- **Pubic hair development**

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This study is based on. . .

Girls of 3 racial-ethnic groups in NHANES III

- **600 Non-Hispanic white**
- **805 Non-Hispanic African American**
- **781 Mexican American**

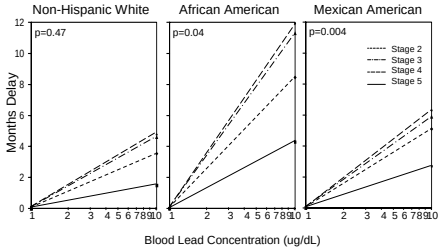
NHANES III is . . .

- **A survey by NCHS / CDC in 1988-1994**
- **Cross-sectional, nationally representative, complex survey**
- **~40,000 civilian, non-institutionalized individuals**
- **Aged 2 months and older**
- **Designed to provide estimates of health status of general population**

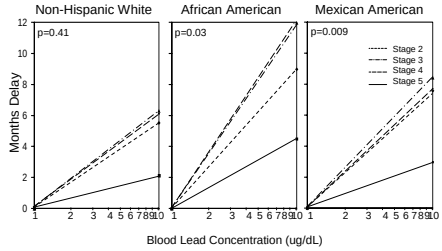
Blood Lead Concentration

Mean (95% CI)	Non-Hispanic Whites N=600	African Americans N=805	Mexican Americans N=781
Blood Lead (ug/dL)	1.4 (1.2 -1.5)	2.1 (1.9 - 2.3)	1.7 (1.6 - 1.9)

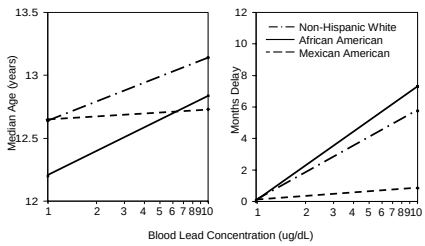
Breast Development Months Delayed



Pubic Hair Development Months Delayed



Median Age at Menarche and Months Delayed



Analyses considered body size measures, smoking and drinking, diet and vitamins, health status and socio-economic status.

RESULTS:

- **The delays were greatest among African-American girls: delays in reaching Tanner stages 2, 3, 4, and 5 associated with a lead concentration of 3 µg/dL compared to 1 µg/dL were 3.8, 5.3, 5.8, and 2.1 months, respectively, for breast development and 4.0, 5.5, 6.0, and 2.2 months, respectively, for pubic-hair development; the associated delay in age at menarche was 3.6 months.**
- **Delays in Mexican American girls were significant for breast (2.4, 2.8, 3.0, and 1.3 months) and pubic hair development ((3.5, 4.0, 3.7, and 1.5 months), but not for age at menarche.**
- **In white girls, there were non-significant delays in all pubertal measures in association with a lead concentration of 3 µg /dL.**

Why are there differences among the 3 race-ethnic groups?

Some differences among the groups:

- **African American girls reach skeletal maturity earlier**
- **African American and Mexican American girls are heavier and body fat is associated with puberty**
- **White girls have longer menstrual cycles and duration of menstrual bleeding than African American girls suggesting differences in hypothalamic-pituitary-gonadal function**
- **White girls also have a greater corticotropin response suggesting underlying differences in hypothalamic-pituitary-adrenal function**

All of these may be affected by exposure to lead.

Animal Data on Lead and Puberty Timing

Lead exposure during development has been associated with growth and sex hormones

- **Prenatal, lactational, pre-pubertal exposure are associated with older age at vaginal opening and first estrus in rats**
- **Prenatal, lactational exposure decreased serum concentration of**
  - **insulin-like growth factor I**
  - **luteinizing hormone and**
  - **estradiol in absence of changes in body weight**

Animal data suggest delay in reproductive development.

Confidence in results?

The results are consistent with what is known about lead in other studies and the way lead acts in the body.

Blood lead concentrations were very low at the time of the study, and probably were higher when the girls were younger – blood lead concentrations peak at about 1-2 years of age, and decline thereafter. It could have been the earlier, higher exposures that were important.

WHAT'S NEXT?

These questions may be answered by a longitudinal study where lifetime exposures are more accurately measured (see the poster for the National Children's Study).